DOCUMENT RESUME

ED 470 088 IR 021 526

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TITLE Integrating Assessment and Research Strategies on a Large Development and Research Project: Kids as Airborne Mission Scientists (KaAMS).

PUB DATE 2001-11-00

NOTE 7p.; In: Annual Proceedings of Selected Research and Development [and] Practice Papers Presented at the National Convention of the Association for Educational Communications and Technology (24th, Atlanta, GA, November 8-12, 2001). Volumes 1-2; see IR 021 504.

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS *Educational Assessment; Educational Resources; Elementary Secondary Education; Instructional Design; Instructional Development; Instructional Materials; Problem Based Learning; *Research and Development; *Science Activities; *Science Education

ABSTRACT

Combining assessment and research components on a large development and research project is a complex task. There are many descriptions of how either assessment or research should be conducted, but detailed examples illustrating integration of such strategies in complex projects are scarce. This paper provides definitions of assessment, evaluation, and research and illumination on how to strategically integrate and manage assessment and research activities by providing examples of tools used to develop and manage a comprehensive assessment and research plan for Kids as Airborne Mission Scientists (KaAMS), a large instructional development and research project. The purpose of the KaAMS project was to develop a series of teacher resources, framed in interdisciplinary problem-based learning approaches integrating authentic and ill-structured problem situations, inspiring teachers to inspire students to pursue the sciences. The goal of the project was to develop informed instructional materials and assess their impact on the target audiences, middle school teachers and students. Thus the project proposal included a strong commitment to formative and summative evaluation as well as a research component. (Author/AEF)

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IR021526

Integrating Assessment and Research Strategies On a Large Development and Research Project: Kids as Airborne Mission Scientists (KaAMS)

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Abstract

Combining assessment and research components on a large development and research project is a complex task. There are many descriptions of how either assessment or research should be conducted, but detailed examples illustrating integration of such strategies in complex projects are scarce. This paper provides definitions of assessment, evaluation, and research and illumination on how to strategically integrate and manage assessment and research activities by providing examples of tools used to develop and manage a comprehensive assessment and research plan for Kids as Airborne Mission Scientists (KaAMS), a large instructional development and research project.

Introduction

Kids as Airborne Mission Scientists (KaAMS) is a large development and research project funded by the National Aeronautics and Space Administration's (NASA) Leading Educators to Applications, Research, and NASA-Related Educational Resources in Science (LEARNERS) project. The purpose of the KaAMS project was to develop a series of teacher resources, framed in interdisciplinary problem-based learning approaches integrating authentic and ill-structured problem situations, inspiring teachers to inspire students to pursue the sciences. The goal of the project was to develop *informed* instructional materials and *assess* their impact on the target audiences, middle school teachers and students. Thus, the project proposal included a strong commitment to formative and summative evaluation as well as a research component.

Definitions

Assessment is an umbrella term that refers to the systematic study of a problem or innovation to make effective decisions about what should happen (Rossett, 1987). In the case of the KaAMS project, the assessment plan defined the objectives, strategies, tools, and protocols used to collected formative and summative feedback.

The formative evaluation component of the assessment plan answered the question 'how are we doing?' as instructional materials were being developed (Morrison, Ross & Kemp, 2001). The focus of formative evaluation was on measuring the effectiveness, efficiency, usability, and acceptability of the material produced so that sound instructional design decisions could be made as the materials were developed and finalized. Feedback collected during formative evaluation served the function of informing the development team how well each of the instructional materials were serving the instructional objectives and what should be done to enhance them.

The summative evaluation procedures were designed to answer the question 'how did we do?' after instructional materials had been implemented with the target audience (Morrison, Ross & Kemp, 2001). Summative feedback focused specifically on the degree to which the major instructional outcomes were attained as a result of using KaAMS materials. Summative evaluation addressed (1) reaction, (2) learning gains, (3) performance changes, (4) education system changes, and (5) impact on the greater society. This feedback was useful in developing implementation plans and supporting materials to train new teachers in the use of KaAMS materials.

Research, on the other hand, is a process of identifying something unknown and then collecting data to make it known (Gall, Borg & Gall, 1996). In the case of KaAMS, the research components focused on analyzing the effect that using KaAMS had on the stakeholders in the middle school learning environment. For example, it was unknown how teaching strategies would be affected by introducing KaAMS into the classroom or whether the use of these materials would affect student interest in pursuing science. Answering such questions can help researchers develop a better understanding of the types of materials and activities that affect instructional and learning processes.

Thus, the purpose of assessment is to gather feedback that will inform the instructional design process. The dangers of having incomplete and poorly thought out assessment strategies are that either required feedback is not collected or time is wasted collecting feedback that is not important to design-enhancement decisions. Thus, the focus of a good assessment strategy must include plans and instruments for collecting feedback that is essential to drawing conclusions about what is needed to develop great instruction. The purpose of research is to gather data on the impact that instructional materials have on stakeholders and the instructional and learning environment. Poor planning of the research data collection process can result in obsolete data, lost opportunities to collect needed data, or data collection conditions that interfere with gathering reliable data. Thus, strategic collection of research data must also be tied to the development process, based on the key research questions, provide flexibility for adjusting to new learnings during product development phases, and seek data that can test theoretical assumptions.

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Although assessment and research literature provides guidelines to develop, manage, and conduct assessment or research, comprehensive examples illustrating how to integrate assessment and research strategies, methods, and tools could not be found in the literature. Published literature on large-scale development and research projects usually contained only brief descriptions of certain components of assessment and research often neglecting to provide detailed descriptions of the relationship among development cycles, feedback and data collection procedures, and assessment and research tools. Therefore, decision-making about design and implementation issues can be problematic if the right amount or right kinds of feedback and data are not collected. Examples that illustrate the integration of assessment and research strategies and tools are scarce. Sharing such examples is therefore beneficial to others developing comprehensive and targeted assessment and research plans. The remainder of this paper will describe and provide examples of the tools and procedures developed to manage and conduct assessment and research on the KaAMS project.

Strategic Planning of Assessment and Research Cycles

The challenge in creating a strategic approach to assessment and research began with identifying the formative and research needs of the project. The literature on instructional development formative and summative evaluation provided guidelines for determining the types of feedback needed to develop sound instructional materials (Dick and Cary, 1985). The scope of the KaAMS project helped to determine who, e.g., teachers, administrators, students, curriculum specialists, would best be able to provide such feedback. Thus, during the development of the KaAMS lesson plans feedback was sough from middle school administrators, teachers, and students on the layout of the material, background resources, terminology, appropriateness of activities, time dedicated to preparation, impressions after using the materials, and thoughts on what worked and what did not during the use of the materials. This feedback was gathered during and immediately after the initial classroom testing of KaAMS.

The research questions were drawn in-part from the purpose of the grant, a literature review on problem-based learning, technology integration in the schools, and career development in adolescents and in-part based on the researchers interests. The research questions probed for understanding on the effects of KaAMS on: (1) teachers use of KaAMS and NASA resources in their classrooms, (2) changes in teaching practices during and after using KaAMS materials, (3) changes in students' success rates in science, (4) changes in students' interests in pursuing science, and (5) diffusion of KaAMS and NASA materials to the surrounding educational environment.

Three cycles of development and data collection

Being a large development project, lasting three years and consisting of collaborations among two major universities, several NASA scientists, and several schools, the KaAMS products were developed in three cycles: alpha, beta, and final versions. The frameworks for the PBL units and major lesson plan components were developed during the alpha cycle. The alpha version was developed based on collaboration among the KaAMS project team that included a group of advising middle school teachers who reviewed and classroom tested the KaAMS materials. Assessment of the alpha materials focused on the appropriateness of the level of content and activity for the students, background information and instruction for teachers, and general organization of lesson plans and associated lesson components.

The beta cycle focuses on using developing a beta version of KaAMS that incorporates learnings from alpha testing, including modifications needed to activities and development of support materials to meet the needs of teachers. Beta testing is conducted with a new set of teachers from a broader group of teachers and students spread across three states. Beta testing focuses on the usefulness of the completed product and how teachers integrate the lesson plans or lesson components into their curriculum. This feedback helps to finalize the KaAMS products and teacher support resources and develop national distribution plans. Simultaneously, research data were, or will be, collected to establish measurement baselines and gather further data on the effects of KaAMS on teachers, students, and the surrounding community. During Alpha testing the research instruments, protocols, and logistics were be tested.

The assessment and research matrix

The first step in developing the overall assessment plan was to document and examine the assessment and research needs. The assessment and research questions were placed in a matrix to develop a strategic view of the feedback and data requirements for the project. The formative and summative feedback needs were cross-referenced to the data collection instruments and questions by subject, e.g., teacher, student. See Table 1.

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Table 1. Example from KaAMS Research and Assessment Matrix: Lesson Plan Development – Formative Evaluation

Lesson Plan Development - Formative Evaluation				
Stakeholders/ Instruments / questions	impressions of layout, terminology, etc. of lesson plans	value / needs of background resources	connections to the curriculum, terminology	value / usefulness / appropriateness of activities and resources
TEACHERS				
TAP A initial interview				
Teacher background	Q4-5			
Curriculum connections			Q1-3	
Lesson plan impressions	Q6-7			Q8
Background content		Q10-13		
Classroom use	Q15			
Discuss KaAMS w/others				
LP Follow-up survey				
lesson used		Q4		Q5
resources used				Q8-9
classroom description during lesson		Q18	Q17, Q23-24	Q19-22
student success				
STUDENTS				
Student focus groups	X	X	X	X
Student classroom documents		X		X
Student journals		X		X

* B=baseline, A=immediately after use, L= long-term follow-up, 1 to 6 months after use P-During prep, Q=question

The research questions were also cross-referenced to the data collection instruments and questions by subject, e.g., teacher, student. See Table 2.

After cross-referencing all of the feedback and data needs by instrument and stakeholder the matrix was examined for gaps and overlap. Instruments and protocols were adjusted to collected feedback and data that were not accounted for in the matrix. For example, it was found that student opinion and artifacts were gathered to assess student success rates, but teacher feedback was not gathered on student success. Questions were added to interview protocols to gather such feedback.

Analysis of the overlaps indicated that there were several instruments and questions gathering feedback on the materials. Since this goal of the project was to develop new instructional materials it was agreed that the level of overlap, especially since feedback was from multiple perspectives of the teachers and students, was appropriate. To ensure that the data collection was not too obtrusive to the learning environment, the next step was to plan the timing for administration of the data collection instruments and protocols.

The assessment strategies protocols called for continual gathering of feedback from teachers and students through multiple strategies, e.g. surveys, interviews, and observations. The KaAMS product development plan laid out the calendar timing for the development and testing of each component of the instructional materials. Examining each instrument and protocol provided an estimate of how long each stakeholder would be required to provide solicited feedback and data. Thus, the timing, by calendar date, and timing in terms of stakeholder commitment in providing feedback through the various instruments were examined. Time frames were established for administering data collection instruments based on the project development timelines and collection patterns for the most appropriate data that would be least invasive to those involved. These estimated timelines were added to the KaAMS Research and Assessment matrix. See Table 2, freq columns.

Table 2. Example from KaAMS Research and Assessment Matrix: Research

KaAMS Research								
Stakeholders/ Instruments / questions	How are teachers using KaAMS and NASA resources?	* freq	How are teachers changing their teaching practices?	* freq	How are student success rates in science changing over time?	* freq	How are student levels of interest in pursuing science-related career changing over time?	* freq
TEACHERS								
Electronic survey								
demographics			Q103, Q114-115, Q122-136	BA L				
teacher attitude			Q1-31	BA L				
percept. of env. for web			Q32-52	BA L				
methods of teaching			Q53-78, Q112-113	BA L				
Resource use			Q79-102, Q104-110, Q111	BA L				
Importance of NASA, Aero, RS to curric.			Q116-121	BA L				
LP Follow-up survey								
lesson used resources used	Q8-9	A						
classroom description during lesson			Q10, Q16, Q27	A			Q19-22	A
student success					Q13, Q15	A		
Classroom Observations	X	D					X	D

* B=baseline, A=immediately after use, L= long-term follow-up, 1 to 6 months after use P-During prep, Q=question

One additional benefit of the strategic matrix was in providing an overall picture of the project development, assessment, and research components. Thorough review of the matrix provided insights into the complexity of the research agenda. This prompted the development of a strategy to use the alpha testing cycle to test the research protocols. This would allow the team to refine logistics for data collection and identify initial findings related to the effects of using the KaAMS materials with middle school populations. However, it is important to report such findings with caution, since effects may be related to additional attention from product development teams.

Additional Planning and Managing Tools

The strategic planning matrix provided the framework for a comprehensive Assessment Plan to be used by the project team to manage the assessment and research processes. The components of the Assessment Plan included text and graphic representations of the overall assessment strategy, teacher advisory panels for alpha and beta testing, roles and responsibilities of assessment team members, components of each evaluation and research procedure, development and data collection timelines, selection criteria for participants, forms for tracking procedural issues, copies of all instruments and protocols, and human subjects approval forms. The Assessment Plan was developed so that each component was tied to the research matrix supporting the data collection needs while keeping the amount of disruption to subjects at a minimum.

The strategic planning matrix also provided the framework for creating a database for all data collected during the assessment and research phases. In this case, a spreadsheet was developed with multiple worksheets. Each worksheet was titled based on the instrument, stakeholder and type of data it collected. This naming structure ultimately helped in the data analysis processes.

The final assessment and research report was also based on the strategic planning matrix. The matrix provided an overview of the data requirements in response to the evaluation and research questions. This overview was used as the planning structure to analyze the data collected and to report on findings based on the project questions. The final assessment and research report

included text and graphic representations for an executive summary of the assessment and research findings, a short summary of the project goals and assessment and research objectives, summary of the formative and summative evaluation feedback and recommendations for each component of the KaAMS material, tables and figures describing results, summaries of the observations and data collected from each classroom, baseline and subsequent description of each stakeholder in the classroom trials, and appendices that described each of the lesson plans tested, detailed notes from observations, interviews, and focus groups, and selected printouts of data analysis on stakeholders. Thus, the information in the summary report was linked to the other assessment and research tools developed for the project, based on the framework established in the strategic planning matrix.

Conclusions

Combining assessment and research components on a large development and research project is a complex task. Creating strategic planning tools can help visualize the feedback and data needs and provide a framework for creating overall assessment and research plans, data collection schedules and instruments, and summary reports.

During KaAMS, several levels of assessment and research were conducted and data were collected from several stakeholders. A planning matrix was created to avoid over- and under-collection of data and assure that the appropriate data were collected. The matrix provided a strategic tool to help cross-reference the collection of different data, at different times, from multiple stakeholders. It helped to identify weaknesses and strengths of the assessment strategies and guided further development of instruments and protocols. The key benefit of such as matrix was in its value to provide a framework for creating an overall Assessment Plan that helped coordinate assessment and research team members during data collection, data analysis, and reporting. This tool, thus, helped to plan and manage the complex task of gathering the right type of feedback and data, at the right time, from the right stakeholders during a large, multi-year development and research project.

Acknowledgement

Project made possible through funding from the National Aeronautics Space Administration, Leading Educators to Applications, Research, and NASA-Related Educational Resources in Science (LEARNERS), a Cooperative Agreement Notice from the NASA Education Division and Learning Technologies Project. Project Number: NCC5-432: Learning Using ERAST Aircraft for Understanding Remote Sensing, Atmospheric Sampling and Aircraft Technologies, (LUAU II).

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